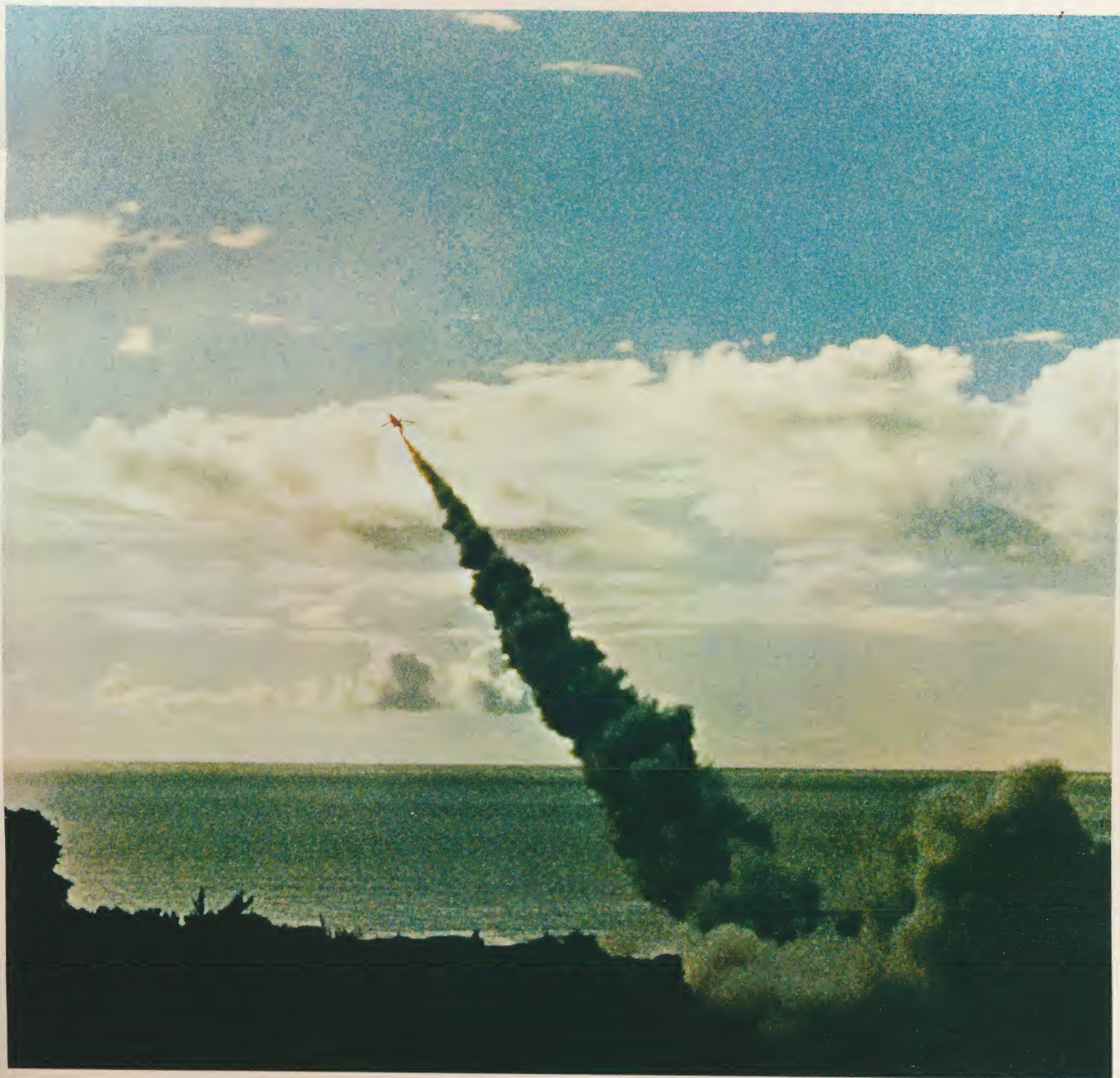


Ryan Firebee Systems





Contents

Introduction/2

Introduction to the Firebee system—background, purpose and capabilities.

Firebee Design and Configuration/7

General description, performance and specifications, structure, power plant, control systems, low-altitude capability.

Firebee Operations/12

Launching and flight, target acquisition/augmentation, scoring systems, recovery and re-use, Towbees, ground support.

Diversified Military Uses/19

Versatile, adaptable Firebee meets particular requirements of the Air Force, Army, and Navy.

Advanced Firebee Systems/22

Continual updating and modification leads to larger payloads, supersonic Firebee; potential non-target uses.

Mid-Air Retrieval System (MARS)/24

Firebee Contracts/26

Firebee Bibliography

Introduction

The first Firebee jet target system began to take shape on Ryan Aeronautical Company engineering boards nearly 18 years ago. It was 1947 when Ryan received the initial contract to develop and produce the first jet-powered airborne target system. Since, through continued refinement of the basic system, several generations of Firebees have made Ryan the acknowledged leader in providing the military services with realistic airborne target systems. Firebees evaluate weapons systems and continue as a high performance vehicle in personnel training for air defense weapons systems.



Built by Ryan craftsmen,

Simulating enemy aircraft, the remotely controlled, pilotless Firebees also serve as tools for evaluating the effectiveness of new missiles as they progress through developmental and operational testing.

Since 1947, Ryan has developed a complete family of Firebee aerial targets to satisfy increasing service requirements. Over 2500 Firebees have been delivered to all three branches of the military and more than 10,000 operational Firebee missions have been flown at U.S. and off-shore bases from Puerto Rico to the Philippines. Firebees have also been delivered to the Royal Canadian Air Force,



air or ground launched (on missile range),



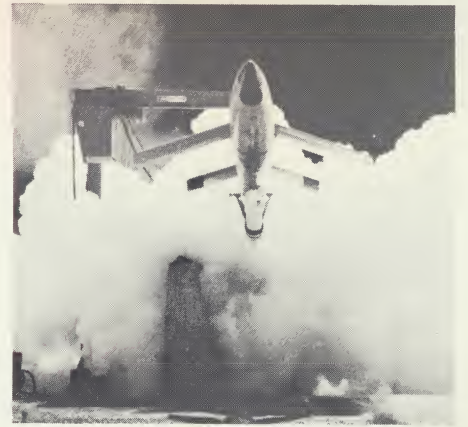
Firebee tests weapon system effectiveness.





and have been flown in support of Arctic cold weather missile evaluation exercises.

The evaluation of the Firebee has satisfied the increasingly sophisticated demands of air defense weapons systems. Present production versions of the Firebee (Air Force and Navy BQM-34A) and (Army MQM-34D) along with the current Navy development of the supersonic Firebee, the XBQM-34E, represent not only an airborne jet target, but a complete system for evaluation of all air-to-air or ground-to-air defense systems.



Ryan Firebees can extend these air defense weapons systems to evaluate performance at the design limits of their capabilities, as well as simulate the enemy airborne threat in all performance parameters, physical size and tactics, including countermeasures.

The Firebee can also perform the vital personnel training function for these weapon systems to the fullest degree of cost effectiveness.

By integrating proven subsystems, the air or ground launched Firebee can also offer a series of formidable, yet economical offensive or defensive weapons systems delivering up to a 1000-pound payload.



Veteran, multi-mission Firebee flaunts its longevity record on fuselage.

Nearly 18 years of uninterrupted target-drone experience has developed within Ryan the largest pool of management, technical, manufacturing and field service talent available in the field today. The Ryan Firebee management organization incorporates the necessary technical disciplines and other specialized personnel resources to successfully accomplish the aerial target-drone requirements for any air defense system, including systems management, design, development, flight testing, tooling, manufacturing and flight services.

Firebee Design and Configuration

Ryan's jet-powered, swept-wing Firebee is a pilotless, recoverable aircraft of advanced design. It is remotely controlled by radio through all normal flight maneuvers. A radar beacon is employed for tracking. Telemetry, when desired, supplies in-flight data to aid the remote control operator.

Major subsystems include the power plant, autopilot command control and stabilization, and remote control and tracking. Systems are available for low-altitude and programmed flight.

As a complete training and weapons evaluation system, the Firebee also carries target augmentation devices to meet varying mission requirements, and electronic scoring equipment. In addition, there is equipment to facilitate landing and recovery when a mission is completed.

Current production Firebees include two versions: BQM-34A (formerly Q-2C) for the U.S. Air Force and U.S. Navy, and MQM-34D for the U.S. Army.

Performance and Specifications

The Firebee's demonstrated capabilities exceed design objectives. It has attained a speed of Mach .96 (635 knots at 50,000 feet), has climbed to more than 60,000 feet and skimmed as low as 50 feet. The speed range of the Firebee is from 200 knots to in excess of 600 knots. The endurance mark of 115 minutes, powered, included 112.50 until fuel was expended, then a 2 minute, 40 second glide, a total of 115 minutes, 30 seconds. It has flown more than 200 miles from its control site, and has flown for more than 77 minutes above 50,000 feet.

Basic gross weight is 2,060 pounds. Length is 22.9 feet, height 6.7 feet, and

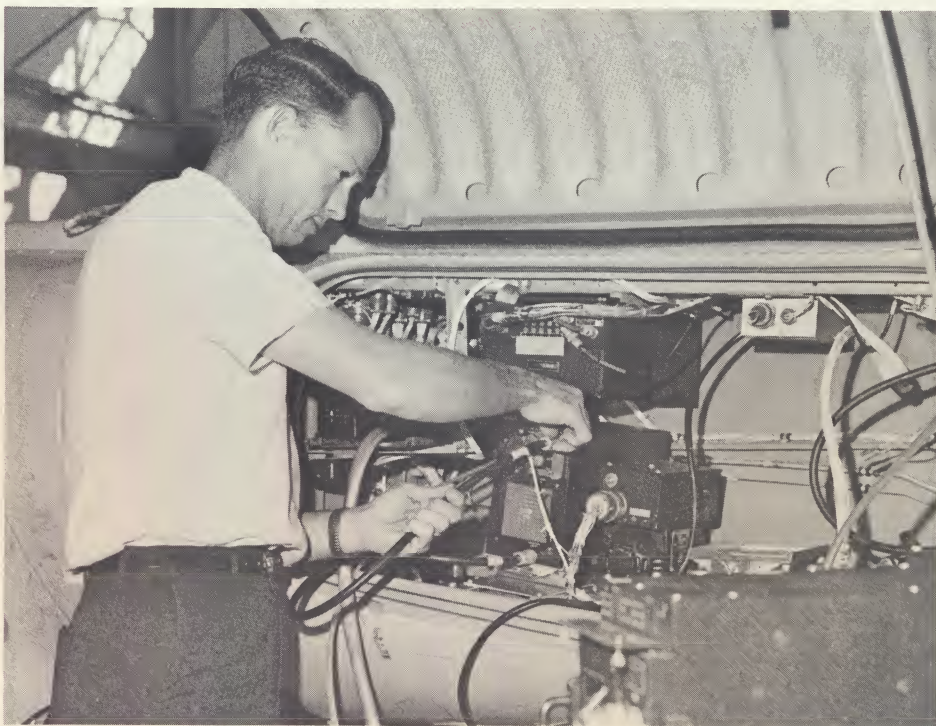
wing span 12.9 feet. Rated thrust of the Continental J-69-T-29 jet engine is 1,700 pounds at sea level.

Structure

Basic structure of the Firebee consists mainly of aluminum alloy metal. The target has five major subassemblies—fuselage, nacelle, wing, empennage, and tailcone. The subassemblies separate for ease of maintenance and repair.

The fuselage consists of a forward section containing four interconnecting compartments, and an aft section with an equipment compartment. The nacelle houses the jet engine complete with engine-driven accessories, tailpipe, and air induction equipment. The 45-degree sweptback wing incorporates leading edge droop to reduce drag, due to lift, and detachable tips to reduce landing damage.

Firebee is designed for ease of maintenance.



Horizontal and vertical stabilizers are also swept back 45 degrees. A fiberglass antenna housing is mounted on the tip of the vertical stabilizer. The tailcone's forward section contains the main parachute. A 45-degree sweptback ventral fin is attached to this container. The aft section, a fiberglass cone attached to the main chute container, is the drag chute container.

Scoring and various other equipments are housed in the fiberglass nose section.

Power Plant

A Continental J-69-T-29 turbojet engine, rated at 1,700 pounds sea level static thrust, powers the Firebee. The engine has a dry weight of 335 pounds, maximum diameter of 25.17 inches, and a length of 44.81 inches. It employs two stages of compression (radial and axial),

a straight-through flow annular combustion chamber, and a one-stage axial turbine.

The engine burns standard JP-4 or JP-5 fuel and uses 10/10 oil for lubrication. The fuel system, including tank, booster pump, and solenoid shutoff valve, is part of the basic fuselage tank assembly.

Primary electrical power is furnished by an engine-driven 28-volt, d-c generator of 200-ampere capacity. A 400-cycle, 115-volt, 250-watt inverter in the equipment compartment furnishes a-c power required by the control systems. Power for electrical devices of the recovery system and for Firebee control during the glide, prelanding phase is provided by a 28-volt, 12.5 ampere-hour lead acid storage battery.

Flight Control & Stabilization

The flight control subsystem automatically stabilizes the Firebee and executes flight maneuvers upon command from the remote radio control site. The Firebee is also equipped with a Ryan-developed flight programmer and/or low-altitude subsystem when required. Each of these provide the flight control system with programmed flight maneuver commands as required for a specific mission profile.

The two-axis autopilot uses conventional aileron and elevator control surfaces to provide roll and pitch stabilization and to execute flight maneuvers. Excellent inherent aerodynamic directional stability of the Firebee, combined with the natural interaction of roll and directional movements, common to all

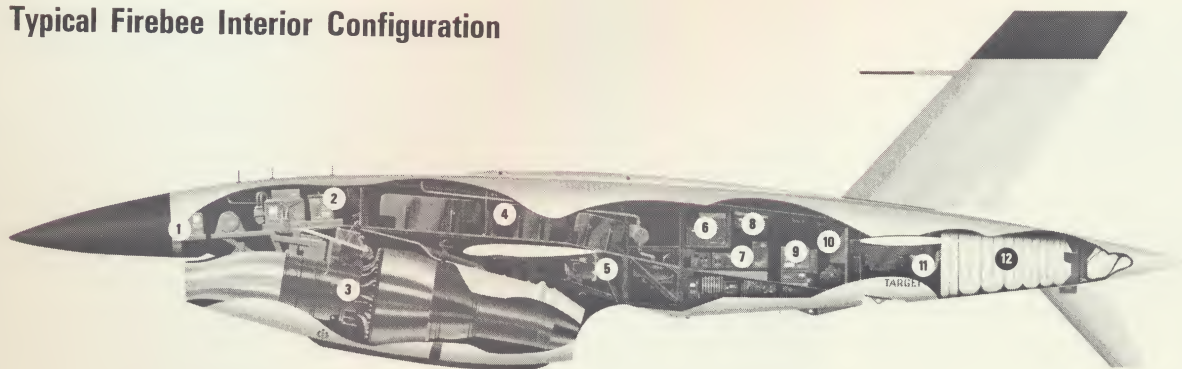
conventional aircraft, eliminates the need for a third axis control system in the autopilot. A small trim rudder is activated by remote command as required.

This system has demonstrated excellent airframe stability throughout the Firebee's entire altitude and speed ranges.

Significant operational features include automatic scheduling of bank angles as well as dive, climb, and glide speeds to obtain optimum performance and to ensure structurally safe flight maneuvers.

An Increased Maneuverability Kit, which makes the Firebee capable of 4g turns at altitudes up to 25,000 feet and 3g turns at altitudes up to 40,000 feet, is available to military users. The IMK may be field retrofitted or installed during factory production.

Typical Firebee Interior Configuration



- ① Scoring Systems
- ② Glide Battery
- ③ J69-T-29 Engine
- ④ Fuel Tank
- ⑤ Aileron Servo
- ⑥ Flight Control Box

- ⑦ Radar Augmentation Equipment
- ⑧ Telemetry System
- ⑨ Radio Control Receiver
- ⑩ S-Band Beacon
- ⑪ Elevator Servo
- ⑫ Parachute Compartments

Remote Control and Tracking

Remote control of the Firebee is normally accomplished through a UHF radio link using an AN/FRW-2 or SRW-4 ground transmitter and an AN/ARW-59 or AN/DRW-29 airborne receiver or similar equipments. The remote command link enables the target to be controlled either from a manned aircraft or a surface station. Remote command includes activation of special scoring and augmentation equipment in the target. It also activates and deactivates the flight programmer, as well as the low-altitude control systems when installed for particular missions.

A beacon in the Firebee facilitates radar tracking from the remote control station. The target's flight path and radar altitude are displayed by ink traces on a radar plotting board which enables the controller to fly a desired mission pattern.

While not necessary to fly the Firebee, a telemetering system is often installed to give the controller pertinent flight

data such as engine RPM, airspeed, barometric altitude, and special instrumentation data.

Basic commands consist primarily of on-off functions which are received by the Firebee radio. These are relayed to the proper subsystem which automatically executes the desired flight maneuver or accomplishes the proper internal function.

Several other types of remote command and tracking systems are used with the Firebee. These include a microwave command and guidance system which integrates the command, tracking, and telemetering systems by means of a common microwave link between the Firebee and the remote station. This system can control the Firebee beyond line-of-sight from a ground station through an airborne relay station. The equipment operates with coded impulses which greatly reduce the possibility of interference from other electronic signals.

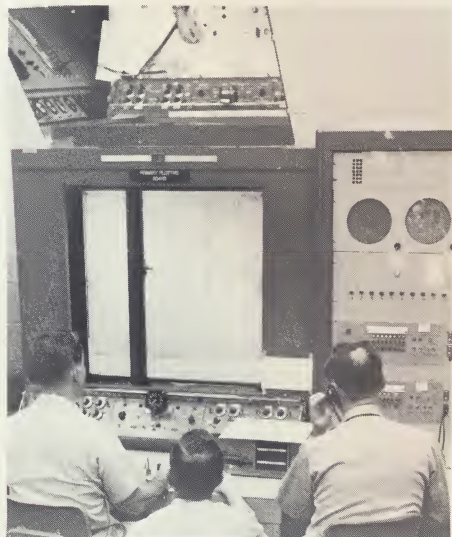
The Firebee has adequate electrical power, available internal volume, and

payload capability to accommodate a variety of guidance and control systems as specified for particular mission requirements.

Low-Altitude Systems

Firebees have been flown as low as 50 feet to demonstrate their capability as challenging targets at altitudes where radar tracking is difficult. Three Ryan-developed systems are available for such missions. The Low Altitude Proportional Pitch System (LAPPS) is a line-of-sight technique to enable the remote control operator to govern the Firebee's altitude by means of ancillary equipment linked with the autopilot. The Barometric Low Altitude Control System (BLACS) provides an automatic altitude control feature capable of operation in the altitude range of 150 to 4000 feet. In the Radar Altimeter Low Altitude Control System (RALACS), the target is controlled automatically at a pre-set altitude within the altitude range of 50 to 4000 feet. Altitude accuracy is maintained by a radar altimeter.

Firebee system's remote command link



provides for target control from



surface station or manned aircraft.



Firebee Building-Block Capabilities

- A1** Photographic Data Link Equipment
- A2** SLAR — Side Looking Aerial Radar
- A3** Television Set
- A4** Typical Photographic System
- A5** Infrared Sensor
- A6** Detachable Nose for installation of various reconnaissance, surveillance and target acquisition sensor systems
- A7** Missile Scoring Equipment
- A8** AN/USQ-1A Matts Bidops
- A9** Luneberg Lens
- B1** Small Pylon Mounted Pods
- C1** Large Pylon Mounted Pods
- C2** Active Electronic Counter Measures
- C3** Chemical/Bacteriological/Radiological (CBR) Delivery Sensors
- C4** Extended Range Fuel
- C5** High Explosive or Napalm
- D1** Tow Bee with TWT Radar Augmentation. Microwave Amplifier, Power Supply and Command Control System retrievable by Tail Cone Parachute.
- D2** Tow Bee with Infrared Flares
- D3** Tow Bee with Luneberg Lens
- E1** Forward Firing Chaff Rockets (Wing Tip Mounted Pods)
- E2** Infrared Flares (Navy Mark 37)
- E3** Infrared Flares (A.F. Type W 211E)
- E4** Wing Tip Camera Pod for scoring only. 4 Cameras
- E5** Wing Tip Pod with Passive Radar Augmentation. (Luneberg Lens or Corner Reflectors)
- F1** Standard Equipment
 - F1a** Flight Control
 - F1b** Radio Control Receiver
 - F1c** Tracking Beacon (L, S, C, or X)
- F2** Special Equipment



**Tinted areas indicate proposed equipment*



Firebee Operations

Firebee operations include launching and flight, augmenting targets to meet the needs of particular mission profiles, and in-flight scoring to evaluate the proficiency of weapon systems and operating personnel. There are also provisions for Firebee recovery, retrieval, and re-use after conclusion of a mission.

Ground support is provided by automatic checkout equipment to eliminate human error and ensure that "all systems are go."

An optional, lower-cost, special-purpose target is provided by the Ryan Towbee which is towed by a Firebee.

Ryan-operated target services are available to military contractors at any installation in the free world. In line with this philosophy, Ryan operates target services at Roosevelt Roads, Puerto Rico, for the Navy, and at the McGregor and White Sands Missile Ranges for the Army.

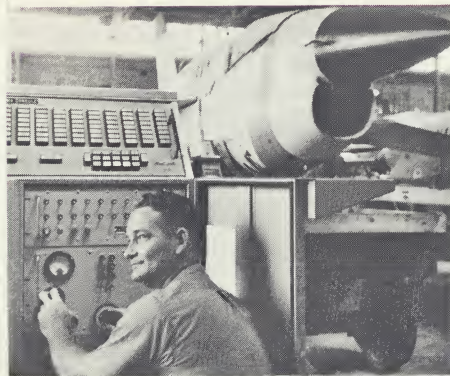


Move Firebees to test station . .

Launching and Flight

The versatile Firebee may be launched either from the ground or air.

Ground launch is from a short rail-type launcher inclined 15 degrees. A mobile, zero-length launcher can also be provided. Firebee engine thrust is augmented during launch by a solid propellant JATO motor which burns 2.2 sec-



"all systems are go" and



four more targets are ready to launch.

onds and provides a nominal thrust of 11,300 pounds.

For air launch, the Air Force GC-130 Hercules launch aircraft is equipped to carry four Firebees, two from each wing. The DP-2E Neptune carries two Firebees. The target may be air-launched from altitudes of 14,000 to 20,000 feet at approximately 200 knots. The remote controller assumes control about five seconds after drop-away.

From either ground or air launch, the Firebee's fully integrated control system enables the remote controller to place the target on course at the assigned time.

Automatically controlled, pre-programmed missions provide the desired combat environment in which pilots, defense crews, radar operators, and air controller can perfect their teamwork and precision.

The programmer also allows flight beyond radar line of sight and with absolute security from stray electronic signals.

Target Acquisition / Augmentation

Firebees employ a variety of target augmentation devices and techniques to enable them to meet varying mission requirements and to aid in weapon system training. Visual, active and passive electronic and infrared augmentation equipment is used.

All the Firebees are painted bright International Orange as a means of visually identifying them. Smoke by daylight and flashing lights at night are available for visual target acquisition.

Flares, mounted on pylons on each wing tip, provide the infrared energy of "enemy" aircraft engine heat. Their wing-tip positions reduce the probability of target destruction by heat-seeking missiles.

Due to the relatively small size of the Firebee, its radar reflectivity is augmented to simulate the size of actual threat aircraft. An active radar augmentation system is configured to meet specific requirements. It provides much greater tracking ranges and compatibility with missile systems than would be possible with bare skin tracking.

The microwave amplification of a Ryan-developed traveling wave tube in the target provides a controllable radar "echo." This enables the Firebee to simulate large aircraft such as enemy bombers, as well as smaller fighter type aircraft.

Passive augmentation, also used on Firebees, consists of wing-mounted reflector pods and/or Luneberg lens of various sizes and frequency ranges. These devices provide augmentation for limited attack angles where small radar cross sectional areas are desired.

Scoring Systems

In-flight scoring systems are used to evaluate the effectiveness of weapon systems, defense crews, and fighter/interceptor pilots. The systems vary to meet particular service requirements. Four systems are currently in use:

USAF—MATTS (Multiple Airborne Trajectory Tracking System)

BIDOPS (Bi-Doppler; Non-cooperative Missile Scoring System)
AN/DSQ-7

Navy—MDMS (Miss Distance Measuring System) AN/USQ-11A

US Army—Acoustical Systems are being operationally evaluated for scoring automatic weapon projectiles and small surface-to-air missiles.

MATTS. The Firebee, missile, and interceptor aircraft are fitted with small transmitters which send signals to two ground tracking stations located many miles apart. These stations continuously and accurately measure the directions of the incoming signals and transmit the data to a computer. Through a triangulation process, the computer calculates the exact positions of interceptor, missile, and Firebee. It feeds this data to a numerical display which shows the miss distance between the missile and the Firebee and the distance between the interceptor and the missile burst position.

BIDOPS. This system is essentially a dual frequency radar self-contained in the Firebee. It determines missile miss distance by detecting the phase difference between the Dopplers of the two frequencies. This phase difference is directly proportional to the instantaneously determined distance between the target and the missile and is telemetered to a remote ground recording station.

MDMS. Using the Doppler principle, this system accurately measures the minimum slant range (miss distance) between the missile and the target, their intercept velocity, and instant of closest approach. MDMS consists of a simple transmitter in the missile, a receiver-recorder at the monitoring station, and a transponder in the Firebee.

Recovery

The Firebee's automatic glide capability enables the remote control operator to maneuver it to a suitable recovery point when a mission is completed or fuel is depleted.

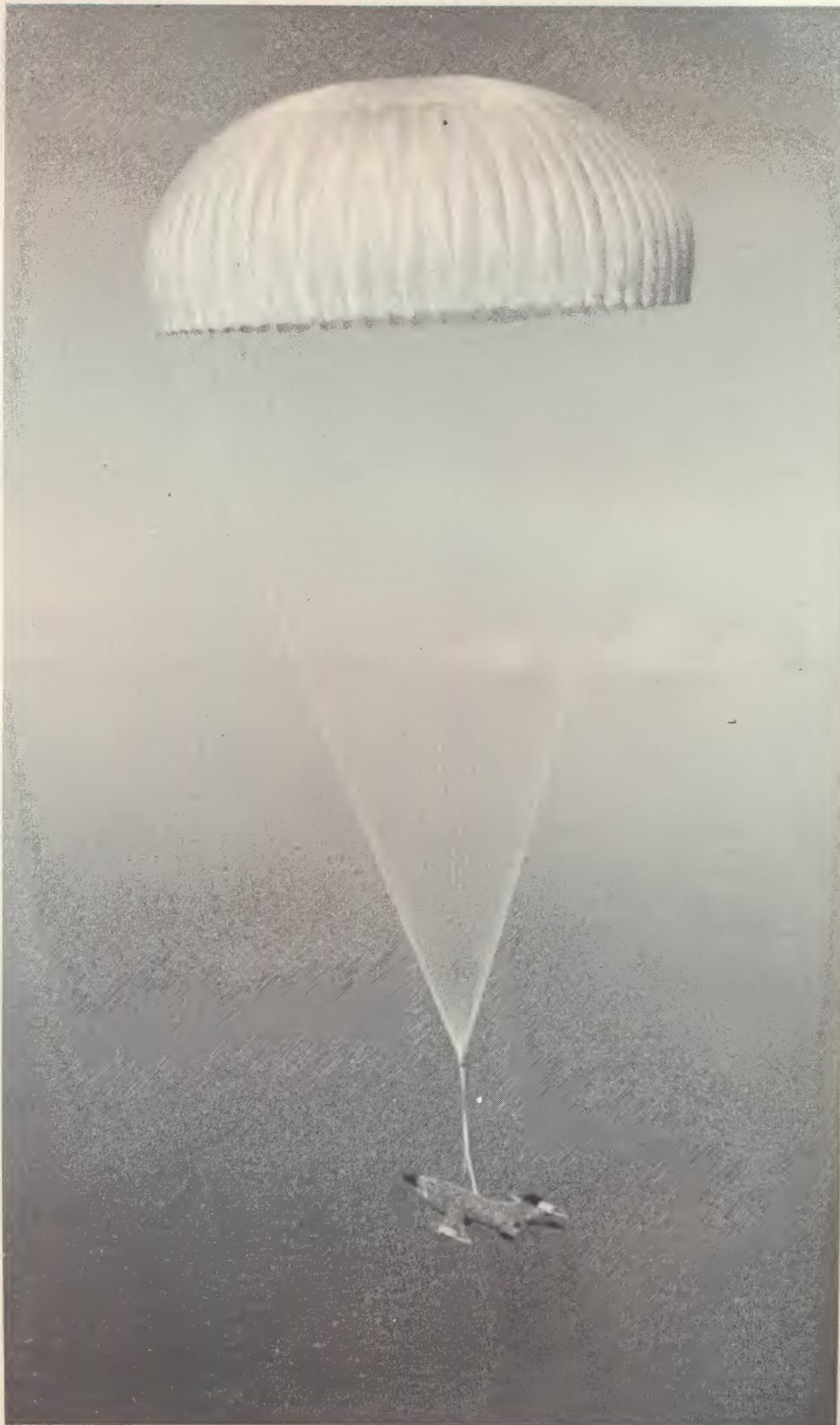
An automatic power-off climb feature ensures adequate altitude for parachute deployment when the Firebee is flying at low altitudes.

A two-stage parachute sequence ensures a safe landing impact. A six-foot diameter drag chute first decelerates the Firebee. The 81.6-foot main chute then lowers it in a horizontal attitude to the ground or water at approximately 20 feet per second. Landing impact is absorbed by the nacelle keel. This protects equipment in the nose and fuselage compartments.

The parachute compartments in the tailcone are detached from the Firebee by electrically ignited explosive devices. A reefing line and timed cutters delay the main parachute canopy opening, reducing initial deployment shock. A main parachute release assembly frees the chute from the Firebee upon land or water impact. This keeps the chute from dragging and damaging the target. Provisions for dumping fuel at the time of parachute deployment reduce impact loads and improve flotation.

Retrieval and Re-Use

Standard airborne or surface equipment may be used to retrieve the Firebee after parachute recovery. Helicopters are preferred for both land and sea operations because of the time they save. However, standard military motorized vehicles can be used for land retrieval, and air-sea rescue type boats can fish Firebees from the water.



The Firebee is capable of riding the seas for indefinite periods. One that was lost floated 24 months in the Pacific before retrieval. Equipped with styro-foam floatation devices for water landings, the Firebee also has a sealed compartment to protect against salt water contamination of electronic components.

Rugged, high-strength metal construction, combined with reliability of the recovery and retrieval systems, give the Firebee an outstanding longevity record. Firebees are returned to service repeatedly, following rapid decontamination after retrieval from the sea and repairs to minor damage. One Navy Firebee flew 37 missions over a three-year period.

Reliability of this target system was demonstrated at a naval base where 65 consecutive flights were made without an operational loss.



After landing, Firebee can be quickly retrieved, refurbished, and returned to service.



The Ryan Towbee / Formation Flying

The Ryan Towbee system provides a special-purpose, lower-cost target for surface-to-air missiles. This inexpensive, expendable target, 6 feet long and weighing about 25 pounds, can carry radar augmentation lenses, infrared flares, and internal scoring system components.

Tow targets are installed on Firebee wing tips. While airborne, a target is launched from the Firebee and paid out and towed by means of a one-way reel containing up to 8,000 feet of steel cable. When the tow line is fully extended, a "presentation" is made to the missile battery. If the missile destroys the Towbee, then the remaining target on the other wing tip is launched and presented to the battery for a second firing. This is technically known as the Towbee sequential system.

The Towbee formation system is basically the same in configuration as the sequential. The difference is that the two Towbees, launched at the same time, are modified in a manner to create aerodynamic side forces as they trail along behind the Firebee.

The purpose of formation flying is to give missile firing units an accurately spaced two or three-target formation to determine missile behavior against multiple targets.

Ground Support Equipment

Ryan has drawn upon its extensive operational experience to produce a complete line of Firebee ground support equipment. This equipment has been proved at operational bases throughout the world, encompassing the complete scope of severe environments. These

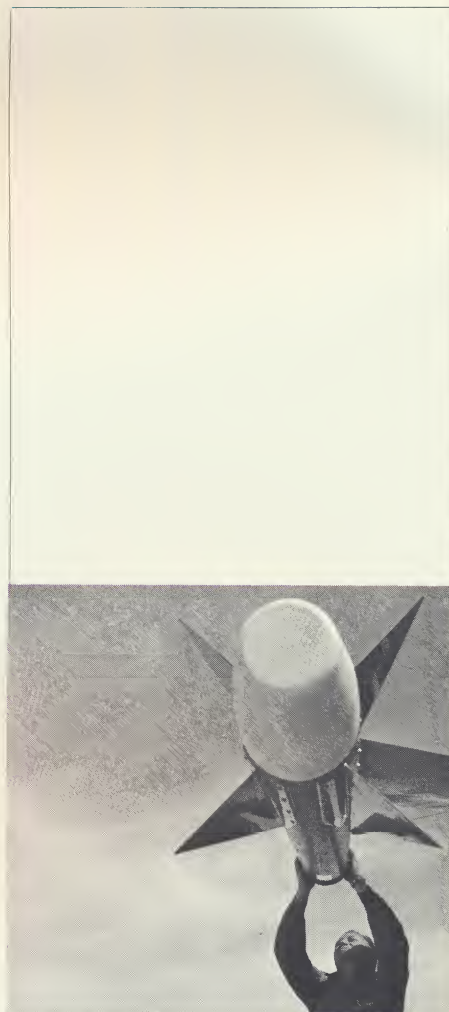
vary from the extremes of cold near Hudson Bay, Canada, to the humid heat of Puerto Rico and Okinawa, to the dry heat of several desert operational sites.

The equipment includes various systems to accomplish a complete cycle of handling, checkout, and testing of the Firebee, its subsystems and components. Both manual and automatic checkout equipments are available to accommodate varying operational requirements. Although the equipment has been designed for semi-fixed base operations, it can be adapted for highly mobile operations if required.

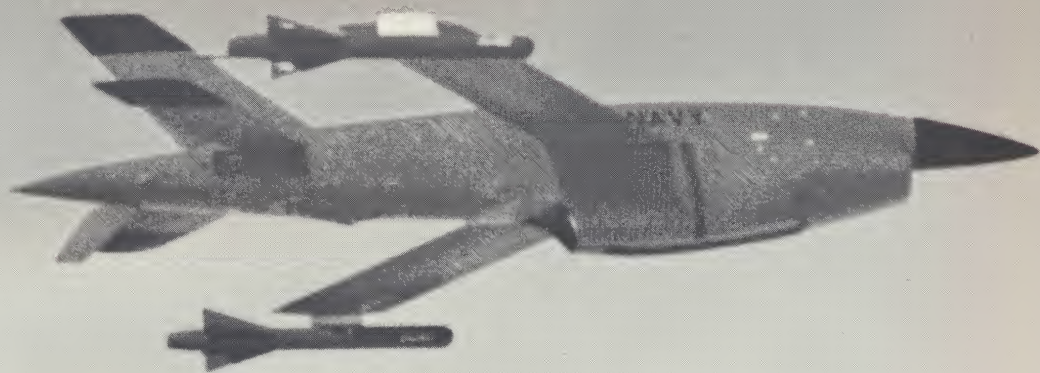
Field Service and Support

Ryan can furnish complete Firebee operational and field service at any military installation in the free world. Its field crews provide contractor-operated services for the Navy at Roosevelt Roads, Puerto Rico, and for the Army at the White Sands and McGregor Missile Ranges, N.M. Ryan also provides field service and support for the Air Force's William Tell weapons meets at Tyndall AFB, Fla. Company target technicians have served the Air Force at Holloman AFB, N.M.

Experienced Ryan on-site technicians have assisted in target operations at numerous Naval installations. These include the Navy Missile Center, Point Mugu, Calif.; Naval Ordnance Test Station, China Lake, Calif.; North Island Naval Air Station, San Diego; the Naval Air Facility, Naha, Okinawa; and the Cubi Point Naval Air Station in the Philippines.



Towbee is wing-mounted.





Diversified Military Uses

The wide capability range of Ryan Firebees is indicated in their diversified use by the Air Force, Army, and Navy, as shown on the following pages.

Firebees Test USAF Capabilities

Firebees simulate enemy aircraft in the U.S. Air Force's William Tell weapons meets, major tests of USAF capability to stop air attacks launched against this country.

The flying targets have participated in these "Aerial Weapon World Series" at Tyndall AFB since their beginning in 1958. That year they provided accuracy tests for such interceptors as the F-89J Scorpions and their Genie nuclear rockets (with inert warheads); the F-86L Sabrejets and their Mighty Mouse rockets, the Falcon-firing F-102A Delta Daggers.

In 1959 the Air Force introduced Falcon and Sidewinder infrared heat-seeking missiles into the competition. Innovations in 1961 included the use of ground-launched Firebees, in addition to air-launched targets. Also, in 1961 SAGE automatic controls from the Montgomery Air Defense Sector were used for the first time in the meet. SAGE vectored F-101B Voodoos and F-106 Delta Darts to the enemy Firebee targets through data link communication.

Many other weapon system developments from the expanding technology have joined these exemplary innovations in the William Tell weapon meets. Ryan has matched these developments with modified and augmented targets to meet the Air Force's growing and expanding requirements.

In addition to the targets flown at the



USAF interceptors "pinpoint" Firebee target.

William Tell meets, the Air Force uses Firebees for weapons evaluation at Tyndall. The targets also support the weapon system R&D programs at Holloman AFB. Several thousand of the latest U.S. missiles have been fired at the Firebee.



Army Pioneered Ground Launch

Lacking carrier planes for air-launching Firebees, the U.S. Army provided contract support for development of the Firebee ground launch system in 1959. In the next few years, both the Air Force and the Navy extended their capabilities to include ground launch.

The first Army Firebees were launched from 80-foot-long rails at White Sands. With successive improvements in launch techniques, the Firebees graduated from rail launch to a zero-length launcher.

To keep pace with the demands of modern warfare, the Army developed a mobile Firebee launcher at White Sands. Based on a flatbed trailer pulled by a semi-tractor, the launcher is towed to remote sites in support of missile firing exercises.

The Army is currently developing its future ground defense systems such as Redeye, Chaparral and close-support

conventional weapons, using the Firebee as the evaluation target.

Firebees also simulate the enemy during the training of Army Hawk missile crews at the McGregor Range.

Firebees have been used at White Sands for six years in support of the Army's ECM (electronic counter measures) test and evaluation program. Designed for installation in larger, manned aircraft, the ECM equipment used demonstrates the target's weight, space, and power provision capabilities.

One of the ECM systems flown in a Firebee weighs almost 300 pounds, has a volume of approximately 3.5 cubic feet, and an electrical power requirement of 5,000 watts. The Firebee missions with ECM aboard have flown at altitudes of 500 to 45,000 feet.

Payloads of 1,000 pounds have been flown by modified Firebees Ryan is producing for the Army.

Army missile crew prepares to test its skill against Firebees.



Army specialty—Firebee ground launch.

Firebees Support Naval Operations

The U.S. Navy has wide and diversified requirements for Firebees. They are used for training in both surface-to-air and air-to-air firing, as well as for R&D of new weapon systems.

Ryan furnishes flying targets in support of fleet operations on ranges at North Island, Point Mugu, Roosevelt Roads, and Okinawa. Firebees have helped to keep Navy defense crews and pilots in their traditional "fighting trim" in competitive exercises such as Operation Springboard and Operation Top Gun. Top Navy fighter pilots have matched skills with Firebees in their F8U Crusaders, F3H Demons, and F4B Phantoms.

Navy missile ships exercise their offensive and defensive weapons systems against Firebee targets under realistic threat conditions.

U.S. Marines employ Firebees to test

the combat effectiveness of their Hawk-firing batteries.

Research and development of new weapon systems is accomplished at Point Mugu and China Lake, with Firebees serving as targets.



Firebees support fleet operations.



Advanced Firebee Systems

In addition to its versatility, adaptability, operating economy, and reliability, the Firebee has another inherent quality that marks it uniquely as a Ryan product. This is its growth potential. It is the basis of the company philosophy which holds that the original concept of any system or equipment must contain growth factors as well as meet the initial requirement.

This has been expressed over the years in many Firebee modifications and improvements to match the expanding technology of new, high-performance weapon systems. It is evident today in the contracts for a supersonic Firebee and a larger-payload, longer-endurance subsonic vehicle.

The growth factor may also be noted in potential special-purpose Firebees. These can be made available for non-target uses such as battlefield surveillance and target acquisition, logistics, and a number of other uses.

Supersonic Firebee

The Ryan supersonic Firebee, XBQM-34E, is in the design stage for the U.S. Navy Bureau of Weapons. The present contract also calls for fabrication of both static and flight test units.

Capable of speeds exceeding Mach 1.5, approximately 1,000 miles an hour, and capable of more than 3g maneuverability, the new-generation Firebee will perform missions at altitudes of more than 60,000 feet. Also the Continental YJ69-T-6 turbojet engine, basically the same power plant used in the near sonic vehicle, will provide increased thrust for the supersonic Firebee.

Slightly longer, slimmer, and with shorter wings than its ancestor, the new Firebee will use flush antennas in har-

mony with its supersonic aerodynamics.

The Navy's new flying target is designed to carry an external fuel pod under its fuselage. After completion of a subsonic mission, the pod is jettisoned for higher-performance, supersonic flight.

In keeping with Ryan economy practices, the design calls for use of many of the components of present-day Firebees.

Laboratory and ground testing related to structural design, engine, and electronic installations will progress through 1966. A flight test program, to be conducted at Pt. Mugu, is expected to begin by mid 1967.

Larger Payload-Longer Endurance

Extra boost at launch and wing-tip extension will raise the payload capability of the Army's MQM-34D to 1,000 pounds, an increase of 300 percent. This allows installation of wing-pylon-mounted fuel tanks to extend flight time. Ryan is currently under Army contract to develop tanks which will double the 100-gallon fuel load of the Firebee.

To get the extra load airborne, a JATO

bottle with 4 seconds burning time has been adapted for the long-endurance Firebee, compared with 2.2 seconds for the 11,000-pound thrust of current JATO units.

Enlargement of the wing area will provide the greater lift needed for the increased load-carrying capability.

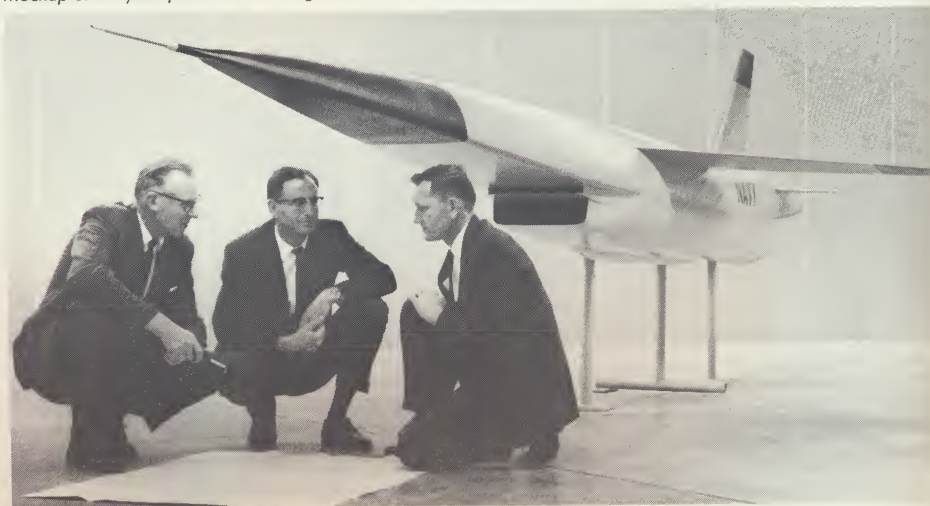
Tactical System

The complex and diverse nature of modern warfare creates a compelling requirement for an unmanned tactical system to perform multiple limited warfare missions. Ryan Aeronautical Company recognizes and is responsive to this need with the Surveillance, Target Acquisition and Munitions Delivery (STAM) program, now under study in the total system definition phase as a complete system.

STAM utilizes the proven versatility, load-carrying capacity and stability of the Ryan Firebee drone as a multi-purpose, aerial platform with universal application.

The Ryan Firebee, fitted with state-of-the-art equipments now available, can

Mockup of Navy's supersonic Firebee generates informal design conference.



gather information/intelligence to aid the commander's decision making process.

Sensors, X-band data link, and ground processing of imagery will be employed. Also, sensors such as photo (with in-flight processing), infrared, sidelooking radar, television and electronic intelligence (ELINT) integrate with the STAM system.

Laser and plasma light developments promise advanced application and increased performance.

Wide band data links of minimum volume and weight coupled with rapid access ground processing subsystems, and supported by precision navigation equipment integrate vital data filtering within the system. This feature places the Essential Elements of Information (EEI) at the commander's disposal on a 24-hour near real time basis.

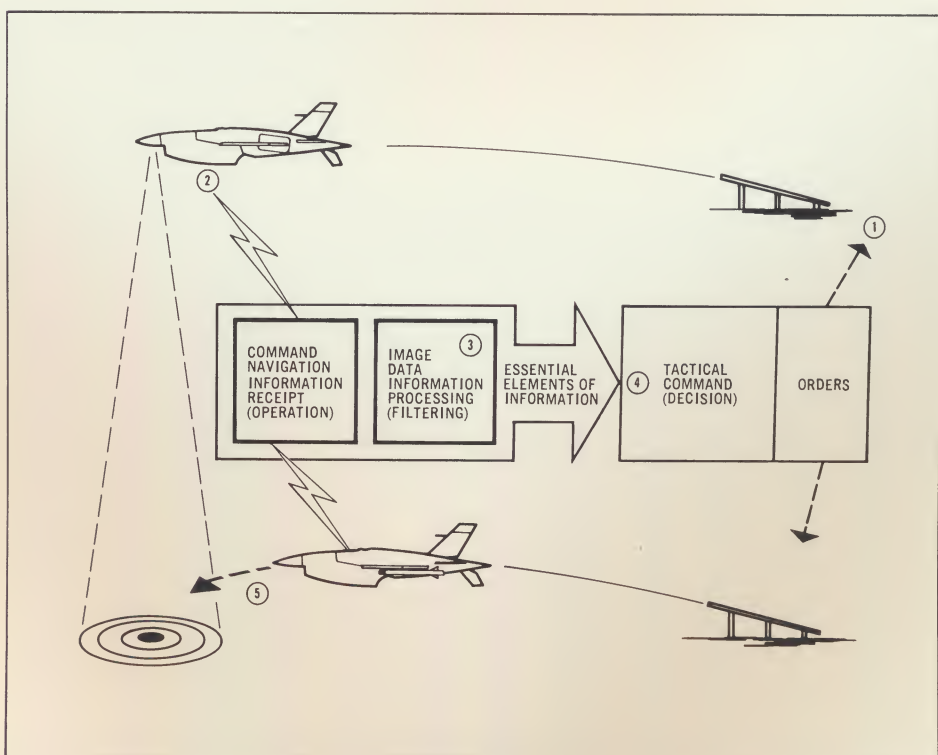
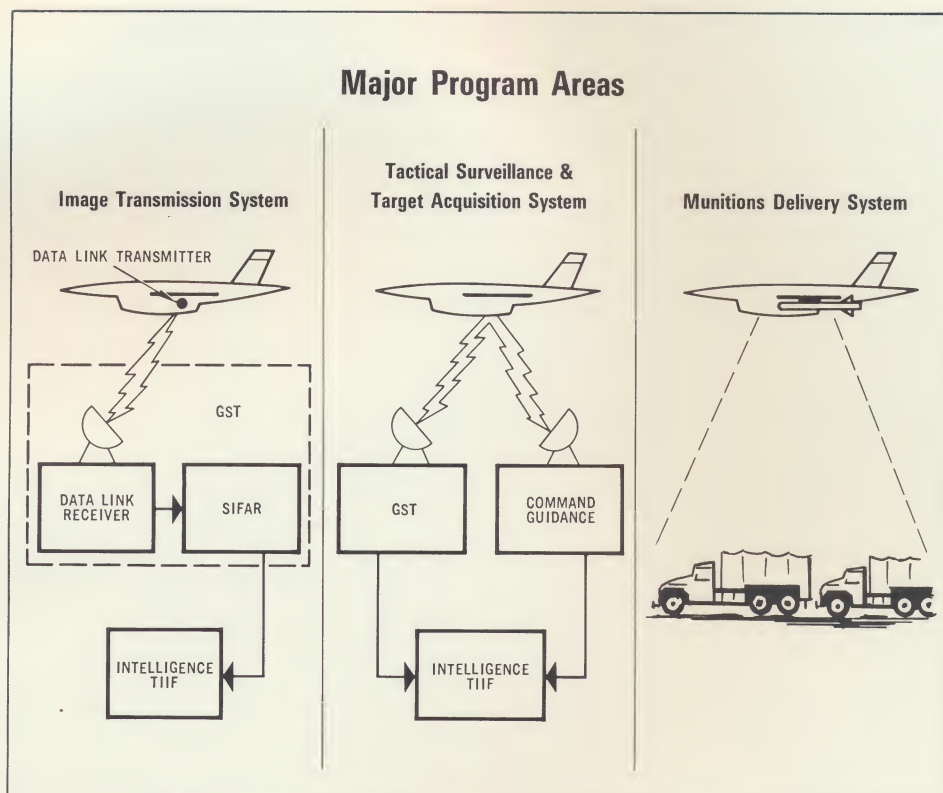
Coupling these features with the Firebee drone's ability to deliver munition payloads of 1,000 pounds plus will result in a total system that satisfies the commander's tactical requirement.

STAM cost effectiveness receives support from these realizations:

- No airborne crew protection is required.
- High reliability through use of proven state-of-the-art equipment.
- "One sortie" to accomplish identification and kill.

Ryan development efforts for STAM are assigned a high priority in an endeavor to provide a near term closed loop system with the mission of (1) searching, (2) locating, (3) filtering, (4) aiding selection, and (5) destroying enemy targets.

The Firebee is also adaptable for cargo, as an airborne weather-reporting station, or radiation detection vehicle.



Mid-Air Retrieval System (MARS)

Successful retrieval of Ryan Firebee jet target drones in mid-air is being accomplished by helicopters using the Mid-Air Retrieval System (MARS).

This system is available to increase the operational flexibility of the Ryan Firebee Target System. MARS requires only the addition of an engagement parachute and a 10,000 lb. test load line to the Firebee. A self-activating quick disconnect fitting is added to free the Firebee main parachute upon MARS hookup.

Helicopters employing MARS are fitted with two poles extending beneath the aircraft, equipped with hooks. Suspended between the poles is a third hook attached to the MARS retrieving line, controlled by a winch reel within the aircraft. Retrieval technique is simple and effective. Radio command initiates Firebee recovery.

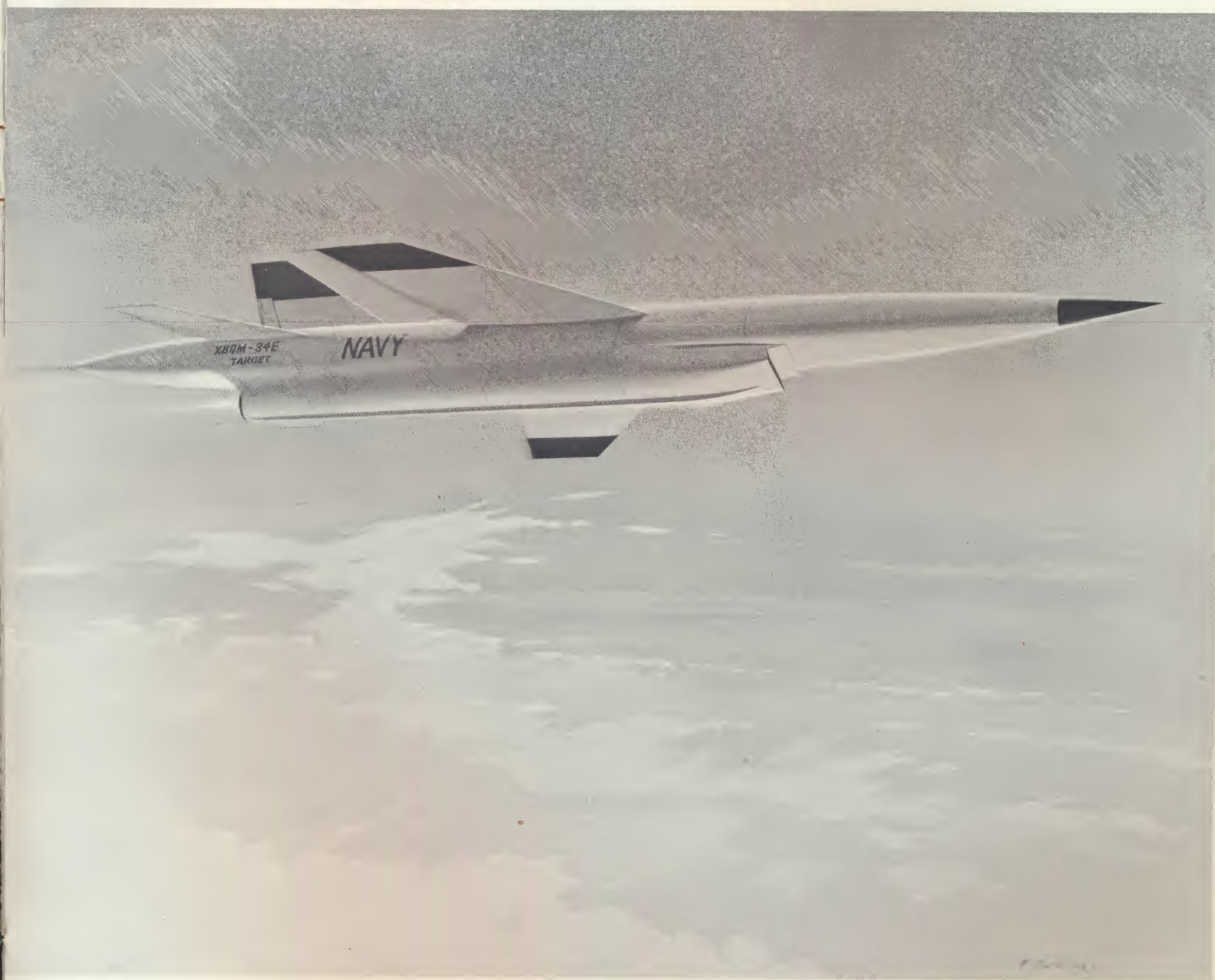
Instantly, a drag chute slows the Firebee to a safe speed. Automatically, the engagement chute and main chute deploy. The load line, leading upward from the apex of the main chute, is kept in the vertical position by the engagement parachute. The pilot of the MARS helicopter flies at 40-60 knots approach speed to pass close over the engagement chute. The retrieving hooks engage the load line. Once hooked up, the self-activating release mechanism frees the Firebee main chute to float clear.

Suspended from the load line, the Firebee is winched up and flown beneath the aircraft back to the service area.

The Mid-Air Retrieval System offers these benefits:

- Valuable drone inventories remain in full commission status.
 - Shock damage to sensitive electronic circuits is prevented.
 - Firebee reliability is enhanced.
 - Turnaround time reduces to REFUEL-INSPECT-PREFLIGHT.
- Reduction of recovery damage to an absolute minimum.

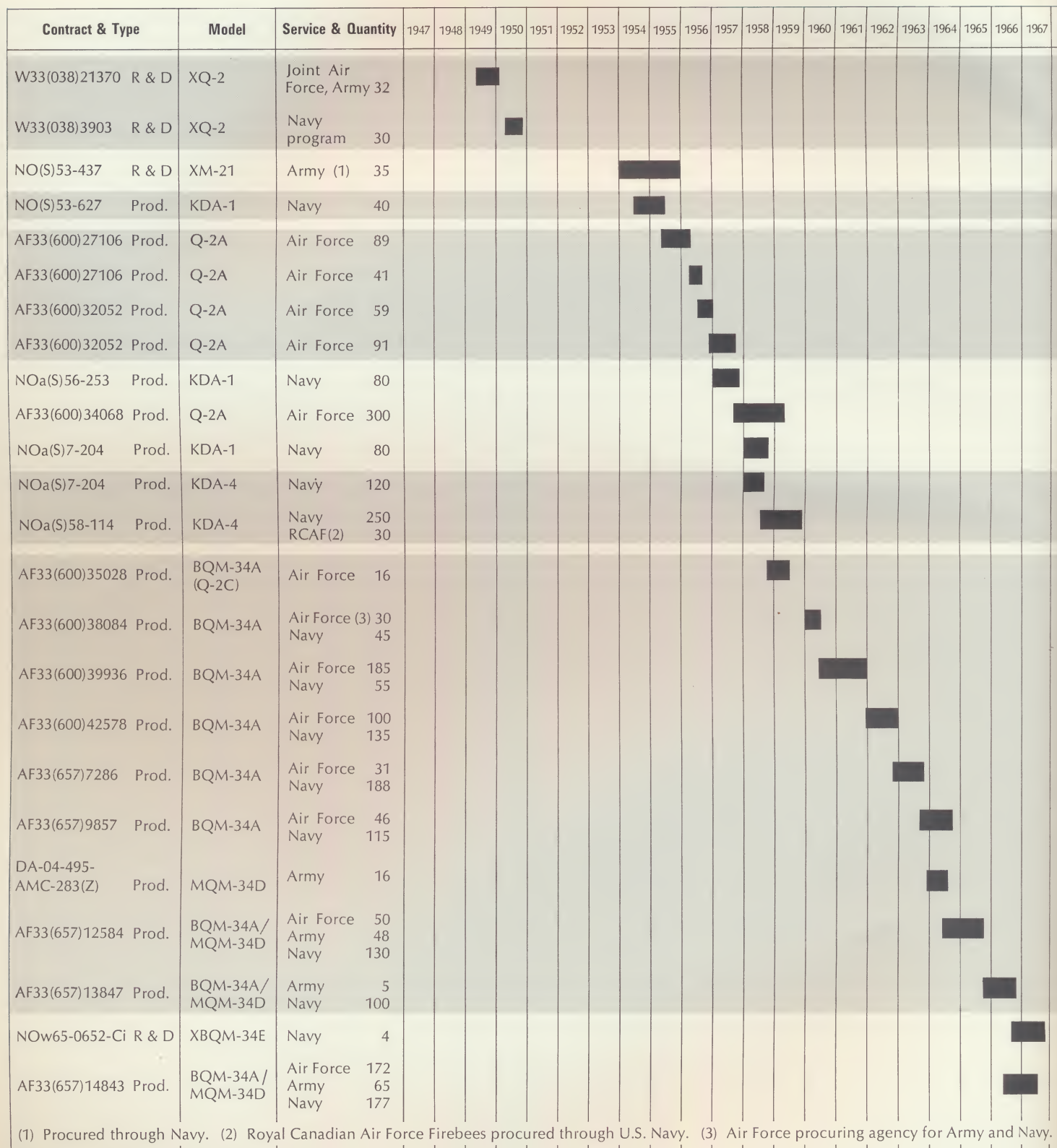




Supersonic Firebee design incorporates capability for more future growth.

Firebee Contracts

Evolution of the Firebee in terms of contracts shows its expanding, tri-service usefulness, both for training and weapon systems evaluation. The bar chart shows production time only.



Modifications & Improvements

Modified Fairchild J-44 turbojet engine. Operations to 30,000 feet. Augmentation—radar: tailcone reflectors, wing-tip pods; IR: standard aircraft navigation lights.

J-44 engine. Addition of glide and flotation systems. Increased salt-water corrosion resistance.

First use of Continental turbojet engine—J-69-T-19—increased operational altitude to 50,000 feet. Improved, Ryan-developed autopilot improved stability. Development of longitudinal stabilization system. Further development of augmentation equipment. First Firebee production runs.

Change to Q-2A autopilot improved roll stability and permitted operational altitude increase to 40,000 feet.

Continental jet engine now used on all Firebees. Ground launch developed for Army (1959), later adapted to supplement air launch of Air Force and Navy. Traveling wave tubes provided electronic radar augmentation. Flares replaced lamps for IR augmentation. Electronic scoring systems added. Glide control feature in stabilization system allowed Firebee control after fuel depletion. Fuselage elongated for more equipment. Wing span increased; leading edge extended forward and down to increase altitude capabilities. Engine thrust increased. Main recovery parachute enlarged to accommodate 400 pounds increased weight.

Development and test of supersonic Firebee.



XQ-2 (Proposed)



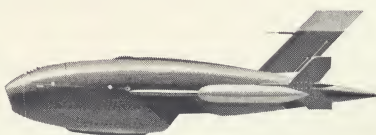
XQ-2



KDA-1



KDA-4



Q-2A



BQM-34A (Q-2C) MQM-34D



XBQM-34E

Firebee Bibliography

Firebee design, operations, growth, modification, new models, target augmentation, field services, reliability programs, etc., are reflected in numerous technical reports and proposals Ryan has prepared during the past 17 years. Publications typical of these functional areas are listed in the adjoining table.

Ryan

Report No.	Title	Date
4117-2	Aerodynamic Performance, 521-Knot Aerial Target	8 January 1948
4117-4	Weight and Balance, 521-Knot Aerial Target	8 January 1948
4117-3	Control Stabilization, 521-Knot Aerial Target	12 January 1948
4943-1	External Load Criteria	18 September 1948
4937-2	Predicted Dynamic Stability of the XQ-2 Target Equipped With Automatic Controls	15 December 1948
4931-3	Airborne Telemetry Equipment	1 April 1949
4929-31	Summary of Study to Increase the Fuel Capacity of the XQ-2 Target Drone	16 June 1950
4929-41	Parachute Recovery Tests, XQ-2 Target Drones	14 February 1951
4929-47	Tactical Application of Q-2 Aerial Target	1 August 1952
4906-2	Ground Launch of Q-2 Aerial Target With JATO	8 September 1952
4929-67	Proposed Control System for Q-2 Aerial Target	11 May 1953
4929-52	Ryan Q-2 Reliability Program	23 July 1953
4906-3	Analysis of Zero Length Launching Characteristics	31 December 1953
4929-54	Out-of-Sight Control System Study Report	25 February 1954
6160-2	Integral Fuel Tank Tests	28 January 1955
4960-3	Proposed Training Program for Operation, Maintenance, and Repair of KDA-1 Target Drone	15 February 1956
4960-8	Summary Report Presenting Results of the KDA-1 Training Program	30 November 1956
4918-8	Telemetry and Instrumentation for XKDA-2 Target Drone	1 June 1957
6159-26	Radar Reflection Measurements	27 June 1957
6159-42	Traveling Wave Tube Amplifier for X-Band Radar Augmentation	22 January 1958
6159-44	Traveling Wave Tube Amplifier for S-Band Radar Augmentation	28 January 1958
6159-45	Traveling Wave Tube Amplifier for L-Band Radar Augmentation	30 January 1958
6159-43	Traveling Wave Tube Amplifier for C-Band Radar Augmentation	7 February 1958
6160-17	Flight Evaluation Program for Model Q-2A Radar Augmentation Equipment and Scoring Systems	1 March 1958
4920-17	Aerodynamic Performance Characteristics, Navy KDA-1 and KDA-4 Drone	11 March 1958

Ryan

Report No.	Title	Date
6159-66	Low Level Altimeter	7 April 1958
12460-4	Suitability Considerations of a Pressure Altitude Reference for Low Altitude Drone Operations	23 April 1958
6159-69	Antenna Pattern Measurements	1 May 1958
12420-1	Preliminary Aerodynamic Performance Characteristics, USAF Q-2C Drone Missile With J69-T-29 Engine	29 August 1958
12460-5A	Scoring Systems for Firebee Targets	10 December 1958
12442-12	Water Drop Tests of Model 124 (XQ-2C) Target Drone	1 May 1959
12442-11	Parachute Recovery System Tests, USAF Q-2C Drone Missile	15 May 1959
12459-35	Quality Assurance Testing for Model Q-2C Target Drone	22 July 1959
12451-2	Preliminary Flutter Analysis, USAF Model XQ-2C Target	1 September 1959
12455-2	Q-2C Subsystem Reliability Analysis	31 December 1959
12442-1A	Structural Design Criteria, USAF Q-2C Drone Missile	1 March 1960
12460-42	Ground Launch Flight Test Program for Ryan Model 124A (Q-2C) Aerial Target Drone	1 June 1960
61B033	Results and Analysis of the Flight and Ground Launch Performance of the USAF Q-2C Aerial Target With and Without a Ventral Fin	21 April 1961
61B043	Study Analysis for Pinpoint Recovery of Ryan Model 124A (Q-2C)	5 May 1961
61B095	Proposed Flight Test Plan Parami Scoring Accuracy Test	8 August 1961
62B008	Reliability Study of the Electrical Recovery System for the Q-2C Aerial Target Drone	1 January 1962
62B070	Ryan Firebee/Towbee Target Systems	28 May 1962
63B075	Q-2C Target System Performance Program	1 August 1963
63B113	Contractor Operated Target Service for McGregor Range	11 November 1963
64B022	Extended Capabilities of the Standard U.S. Army Missile 124E Guided Missile Target System	14 February 1964
64B055	Proposed Program and Cost Estimate for U.S. Army Firebee Surveillance and Target Acquisition System	10 April 1964
64B093	U.S. Pacific Fleet Firebee (BQM-34A) Target Aircraft Services Study	15 July 1964
64B112	Firebee Ground Launch Facility for McGregor Range	1 September 1964
64B126	Radar Augmentation for Target Missile	28 September 1964
12469-7	Flight Test Summary Report, Increased Maneuverability Kit	7 March 1966



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